

AEROSPACE
SYSTEMS
SERIES

SOME MAJOR IMPACTS OF THE NATIONAL SPACE PROGRAM

I. Identification of New Occupations-- Formulation and Initiation of Study

Prepared for:

I.P. HALPERN
NATIONAL AERONAUTICS AND
SPACE ADMINISTRATION
WASHINGTON, D. C.

May 1968



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**SOME MAJOR IMPACTS OF
THE NATIONAL SPACE PROGRAM**

**I. Identification of New Occupations--
Formulation and Initiation of Study**

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**SRI Project MU-7227
NASA Contract NASW-1722**

FOREWORD

This is the first in a series of task reports within a brief study of "Some Major Impacts of the National Space Program."

Within this investigation, many candidate impacts were first screened and those that appeared (a) minor, or (b) not likely to yield to sufficient study within the short time available, were eliminated. The remaining impacts were subjected to further study and each is separately reported within this series.*

The results of this study are the first concrete assays within a welter of conflicting, incomplete, exaggerated, and frequently unsupported information. Stanford Research Institute considers their objective study an important task and is looking forward to extend the scope of this study in the future, by application of the background, methodologies and initial results obtained to date.

John G. Meitner
Project Manager

* The titles are: "Economic Impacts," "Identification of New Occupations," "Impacts of New Materials Technology," "Impacts Upon Aviation and Aeronautics," "Impacts Upon Health, Biology and Medicine," "Some Total Impacts of NASA Capability," "The Impact of the Space Program Upon Science--1. Astronomy."

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INTRODUCTION AND SUMMARY

The objective of the overall study initiated here was to define that economic impact of the space program which accrues to the nation in terms of new occupations; the more immediate objective was therefore to identify these.

In order to arrive hopefully at comprehensive identification schemes for the space effort-generated occupations, several methods were defined; some of these methods were examined and validated--mostly in the Los Angeles area.

On the basis of this preliminary pilot experimentation, a) several candidate search methods were thus refined and established, b) others (not yet fully tested) were additionally conceived, (c) a study plan was formulated on the basis of (a) and (b), and d) some 18 new professional and blue collar occupations--formally established by job titles--wholly derived from the space program were already identified; these range from assistant spacecraft manager, through life support research scientist, to space documentation requirements analyst and space structures assembler.

In the light of our initial experience, the search methods selected for further study are likely to yield additionally a number of new occupations that exist solely as a result of the U.S. space effort; these search methods take into account basic problems encountered in the pilot survey described in the following pages--mostly the inconsistencies and the accidental or deliberate lack of descriptiveness in job titles, the confusion in existing skill indices, the recurring revisions of occupational titles within the aerospace industries, the formal (non-descriptive) and the informal (descriptive) lists of job titles employed simultaneously by the same organization, and the usual overlap between missile-and space-applied occupations. We believe that the search methods designed by SRI will be successful in identifying and perhaps obviating some of these problems. Further study of this type is necessary, because we are surprised to find how many professionals and blue collar workers exclusively engaged in space work (in NASA and industry installations alike) have titles that go back to the beginning of the aircraft age. There is, obviously, a need to accelerate the adoption of new and space-related job designations and in order to accomplish this--while identifying those job categories already up-dated--further study is required, to make appropriate recommendations for action.

The present report (a) discusses the results of the pilot study--i.e. the search methodology established for future study and the new

occupations identified to date--and (b), describes the remaining study portions required to fulfill the second objective--i.e., a fairly comprehensive identification on a national basis of the new occupations already in existence as a result of the U.S. Space Program. We wish to delay the formulation of a final study to relate the results of the occupation identification to the economic impact thereby generated, because a better understanding of the occupational titles and their bearers is first required, along with further identification of these occupations.

In the light of our early returns we are reassured that many widely varying occupations already have been created as a result of the space effort; in the light of other impacts studied (and described in other reports of this series), we also feel that the suggested collection and documentation of new occupations would spell out a rather consequential impact. On that basis we strongly recommend the continuation of the study discussed here.

INITIAL RESULTS--NEW OCCUPATION TITLES DERIVED FROM SPACE PROGRAM

Definition of "New Occupations Derived From Space Program"

For reasons relating to provability (and discussed below in the section entitled "New and Old Space Occupation Titles"), our search for new space-derived occupations was restricted to those that simultaneously answer to the following requirements:

- a) self-evidently space-related or space-derived occupations,* and
- b) occupations described by formally established, space-specific titles.**

Our results are, therefore, expressed in the most restrictive lists possible, but simultaneously will not yield to argument by devil's advocacy.

The background, rationale and description of the search methods employed is discussed in a subsequent section of this report entitled "Discussion of Initial Study and Methodology." The results obtained to date follow directly below.***

Results From Search Method I

Initial returns from 7 organizations among the total of 14 contacted to date have indicated 11 new, exclusively space exploration-derived occupations.

We are impressed that so brief and restricted a search, has already yielded such widely varying new occupations. We are therefore confident

* This excludes a general machinist or an accountant on the Surveyor Program.

** This excludes the lunar spacecraft antenna engineer, whose actual job title is electronic engineer.

*** Additional results are now reaching us daily and others will continue to be submitted, as a consequence of delays in responding to inquiries we made earlier; because this program was only funded for some 10 days, this report describes only the results obtained by the cut-off date, 20 May 1968. The additional data will be reported to NASA in conjunction with the results obtained during the next study phase.

that a fairly large number of genuinely new space exploration-derived occupations does indeed exist in the aerospace industries, in NASA Centers, and in many government agencies, e.g., ESSA, FCC, HEW, etc.

A list of the 11 space-derived occupations so uncovered to date follows:

- Assistant Spacecraft Manager (35)
- Environmental Space Systems Assembler (15)
- Life Support Research Scientist (15)
- Space Documentation Requirements Analyst (34)
- Space Labs Supervisor (15)
- Space Lab Unit Supervisor (15)
- Space Structures Assembler (1)
- Space Systems Superintendent (15)
- Space Vehicle Checkout Mechanic-
Electro-Mechanical Systems (33)
- Space Vehicle Test Mechanic (36)
- Space Vehicle Test Mechanic-Electronics (36)

Results of Search Method II

The list of the 7 occupations found by this method is as follows:

- Circuit Design Specialist-Space Instruments (40)
- Engineer-Life Support Hardware (3)
- Environmental Control and Life Support Engineer (43)
- Lab Technician-Space Instrumentation (29)
- Space Electrical Power Engineer (38)
- Space Power Systems Engineer (22)
- Solar Cell Engineer (21)

New and Old Space Occupation Titles

As indicated above, we discussed internally the possible semantic nuances and differences between "occupations," "job titles," "type of work," etc. and we decided to look--to start with--for self-evidently space-related occupations, i.e. those that have an unequivocally space-specific description, for example (and ideally) "astronaut." Because we also wished to differentiate between "effective" and "actual" occupations and only report the latter, we decided furthermore to restrict

our results to job titles already established and used.*

The above lists indicate our results within these tight definitions. On the other hand, we are struck by the thousands of job titles we found for personnel in space-generated jobs in NASA and in aerospace industry organizations that are not space-specifically titled, i.e. the "space-structure assembler" whose title is "assemblyman" (jr., sr., etc.), the "space radiation instrumentation specialist" whose title is "physicist," and the "life support equipment designer" whose title is "(lay-out) engineer," etc. (11, 12, 25, 26, 27, 28, 41).

The questions we raise are: a) why is there such a very high ratio between old (evasive, incorrect, or general) titles to specific (description) titles for spaceworkers, and b) if the inertia factors can be identified and deliberately overcome, is it not high time in the second decade of the U.S. Space Program to have its operators identify properly their highly specialized personnel.

Answering the second question in the affirmative, SRI is interested in continuing the present study, so as to arrive at useful answers to the first question.

Transitional Attempts

Several organizations responded to our inquiries for information with an "officially we use neutral titles for our space-oriented personnel, but we have unofficial, space-specific titles" (anywhere from company-private reorganization plans, to long-range planning for critical personnel in future space programs) (10, 19, 23, 30, 32). One such (unofficial) list (37) contained both, space-specific and non-space job

* The difference is in the proof and anticipates a devil's advocacy in documentation: consider a highly specialized electronic technician (too young to have worked in aircraft or missile electronics) whose first job it is to check out--after specialized training--fuel cell control circuitry. If his employer officially lists him as, say, a "life support equipment technician," he enjoys without doubt a new, space-derived occupation. However, if all other things being equal, he is listed by his employer as an "electronic technician," the proof of a new occupation cannot be made unequivocally--the problem then becomes general and one could a) declare that there are now X-billion space-derived wages paid per annum, ergo there must be Y-thousand new "space" occupations, or b) if pressed for details, one could generate thousands of specific job titles, for jobs that do in fact exist (from "spacecraft assembler" to "lunar soil analyst") but are not so identified by the employers.

titles; the former were extracted and are as follows:

- Spacecraft Electronic Equipment Assembly Mechanic
- Spacecraft Final Assembly Checkout Mechanic
- Spacecraft Final Assembly Electrician and Electronics
Checkout Mechanic
- Spacecraft Final Assembly Hydraulic Checkout Mechanic
- Spacecraft Inspector-Electronic Assembly
- Spacecraft Inspector-Electronic Testing
- Spacecraft Inspector Final Assembly-Electrical
- Spacecraft Inspector Final Assembly-Mechanical
- Spacecraft Inspector-Major Assembly
- Spacecraft Inspector-Major Electronic Systems
- Spacecraft Inspector Pre-Flight Electronics
- Spacecraft Inspector Pre-Flight Mechanical
- Spacecraft Installation Mechanic
- Spacecraft Pre-Flight Mechanical Inspector
- Spacecraft Structures Mechanic
- Spacecraft Welder-Precision
- Spacecraft Welder-Production
- Space Vehicle Pre-Flight Electronics Inspector

In addition, we were elsewhere (and in confidence) shown several such lists of varying degrees of implementation potential and attendant hues of proprietary. In the light of the latter, we wish to indicate here (without reference) only by a few tentative titles, several hundred of these now under study by several space systems organizations:

- Artificial Gravity Engineer
- Electronic Space Simulation Engineer
- Lunar Chemist
- On-Board Systems Engineer
- Planetary Atmospheric Meteorologist
- Space Bio-Technology Scientist
- Spacecraft Harnessing and Cabling Technician
- Space Radiation Physicist
- Upper Planetary Atmospheric Scientist
- Etc.

DISCUSSION OF INITIAL STUDY AND METHODOLOGY

Purpose

The chief purpose of the initial study was a) to chart possible search methods to identify space program-derived occupations; b) to deploy and test some of these in a sampling manner--and on that basis to adopt and refine these search methods (or to reject them) for future study; and c) most immediately, to identify as many space program-derived occupations as possible through (b).

The tight definitions discussed in the preceding section were adopted so as to avoid any ambiguity of results, i.e. it was one of the purposes of this study to arrive at a restricted but unassailably documented list of job titles by which the new occupations were already defined officially.

Search Methods

The initial methods charted for identifying the space program-derived occupations include a) the query (in conference) of industry and NASA personnel managers; b) the study of newspaper employment advertisements over a period of the last twelve years; c) the search and study of Department of Labor's "Dictionary of Occupational Titles;" d) the search of Bureau of the Budget's background and Interagency Occupational Classification Study; e) the study of the National Register of Scientific and Technical Personnel.

Of these five methods only the first two could be briefly examined (mostly in the Los Angeles area) in the short time available; in spite of these constraints, 18 new space-derived occupations were thus already identified (see section "Description of Initial Results," above); a brief description of the five methods and our experience to date follows.

Search Method I--Query Personnel Managers, etc.

By proper introduction--an important requirement--conferences with 23 directors of personnel matters ("Director of Executive Compensation," "Personnel Director," "Assistant to President," etc.) were arranged in 14 industry and government organizations and our interest in identifying new occupations unequivocally based upon or derived from the space program was discussed.

The requested material at the time of this writing was obtained

from four contacts--other returns are expected. The material received was very pertinent where descriptive job titles were employed by the responding organization (6, 18, 44, 39).

On the other hand, there is a widespread utilization of "Member of Technical Staff" (MTS) designation for all or large segments of the salaried staff of several aerospace corporations. Within the broad MTS designation, maturity curves are employed to establish the level at which individuals operate. Specific tasks or responsibilities are not designated in job titles (13, 17).

Another general type of classification encountered in generic in form, and the designations are not indicative of an individual's function; examples of this are: Senior Engineer, Test Analyst, etc. (14, 16).

Most companies maintain a skill index on their personnel (20, 43), but since this is not sufficiently parallel with the study, it can only offer supplementary instead of decisive resolution of our problem. Additionally, it is interesting to note that the industrial aerospace companies do not appear to consider these indices of great benefit (20, 43) because 1) a priori, it cannot be assumed that employees remain current in the areas designated, since the dynamic nature of allied fields demands constant up-dating, 2) the terminology is so imprecise that actual training or ability is difficult to assess from the designations used by individuals, and 3) the problem is compounded when efforts are made to systematize the skill indices. Therefore, when a company is staffing a new project, the massive potential of the extensively developed systems capability is bypassed, in many instances, for the time-tested approach of, "Ask Joe."*

Similarly, we followed up one extensive (and non-yielding) inventory of job titles in an aerospace company by obtaining job descriptions (7, 45) and by further work we can perhaps--as with the application of skill indices--arrive at independent generations of occupation descriptions.**

This was already indicated to be possible by two other constraining exercises applied to the non-descriptive job-title inventory involved: a) a personal identification (3) of those non-descriptive job titles that are exclusively space-work related (by the "Man Who Knows"

*This anomaly is at once both curious and provocative--in itself perhaps worthy of in-depth study.

**We do not lightly invoke the specter of semanticism, but there is, of course, such a component in this task, and we hope to overcome it as indicated.

in the personnel department of an aerospace company). This MWK (9) thus selected by hand 15 job titles in a total computerized inventory of several hundred!*** b) The other technique consisted of co-directing this identification process by focussing among those companies--or organizational areas within companies (department by department)--that are involved in pure space work or space-derived work, and--perhaps additionally arrive at possible "technology transfer" positions in their client's organizations (4). An example is Space Labs, Burbank, California; we intend to seek from such a company its own job classification list and the names of clients that have purchased some of their space-generated bio-medical equipment--e.g. the intensive care section of the Good Samaritan Hospital, Los Angeles, California. From the hospital, we will determine the titles that have been given to the nurses and technicians assigned to this new equipment.

We plan to expand this "Search and Query" method nationally a) to other aerospace companies, appropriate NASA and DOD organizations; b) to the pertinent headquarters offices of other government agencies (ESSA, DOC, etc.); c) to career centers and to national employment agencies such as Decision Incorporated, Engineering Opportunities, etc.; and d) to the university career curriculae for a better understanding of threshold occupations. A brief discussion of this is presented in the section entitled "Description of Future Program," below.

Search Method II--Study of Newspaper Employment Advertisements

SRI collected and examined a list of about 800 aerospace job advertisements in the Los Angeles Times over a period of 12 years. The study proceeded briefly as follows:

1. We selected at random a single date in 1955.
2. For that date, and for a date close to it in each third year thereafter to the present, we prepared a list of all aerospace jobs advertised.
3. We then edited the five lists to establish consistency of wording and eliminate duplicates and inconsistencies within each list.
4. Subsequently, we compared each of the lists, later ones with earlier ones, to extract newly advertised job categories in successive years.

***These are: Elec Tech Prod Tst Gse; Inspec R & D Elect; Inspec R & D Mech; Lab Prec Mech; Lab Prec Mech Tech; Mech Struc Bonding; Metrol Procds Anlst; Metrol Procds Desgn; Metrol Procds Wtr; Painter Ablative Coating; Sealer & Bonder Gn; Sealer and Bonder; Space Simul Tech - Test; Space Vehcl Ckt Tec El; Space Vehcl Ckt Tec Mc.

5. Finally, we edited these lists to determine those most nearly representative of the search objectives, that is, space-oriented and/or space-derived occupations.

Selection of Dates: In the initial stages of the study, some discussion was given as to which specific dates (years) to choose. We hypothesized that it probably made little difference which date was chosen within a year, but it appeared that something could be gained by preparing several lists, differing by several years. Theoretically, all that would be necessary would be two lists, past and present; a comparison of one with the other would then reveal the new jobs being searched for.

From the practical standpoint, however, the use of two lists only clearly had flaws--the main one being that the lists generated would be far from comprehensive, and certainly not consistent enough to expect a clear separation of new jobs from old ones. For this reason, the five different dates were chosen. The beginning year, 1955, was selected to predate the formation of NASA; 1958 was chosen to coincide with the formation of NASA; and three dates were chosen in the ten year interval thereafter, until 1967.*

The lists of jobs generated in these five years varied in length, as a function of many different variables--the job market itself, of course, being the prime operator. Furthermore, it was no more possible to expect complete consistency from one list to the next for five sequences than it would have been for two sequences. What clearly was established, however, was the delay time in the appearance of new job categories. From the entire series of samples, no new jobs meeting the selection criteria were found in 1955 or 1958; 6 possibly new jobs were found in the 1961 list; 5 possibly new ones were found in the 1964 list; the remaining 16 possibilities were found in the 1967 list. (The "List of Possibilities" is described later.)

Preparation of Job Lists: The preparation of the SRI job lists was extracted from microfilmed copies of the selected issues of the Los Angeles Times. Again, in formulating the study some discussion was given to methods of simplification and increased efficiency. For the pilot study the method used proved satisfactory. On a larger scale, however, other mechanisms for the preparation of initial lists may be warranted.

* The initial date was chosen at random for the first year. Thereafter, to obviate seasonal effects, if any, dates close to the first one were chosen. The dates selected were: April 3, 1955; April 6, 1958; April 2, 1961; April 5, 1964; April 2, 1967.

Editing and Data Processing: About 760 job titles were collected in preparing the five lists described above. From the experimental standpoint it was apparent that some type of computer processing might be appropriate in extracting relevant jobs from this sample. Our procedure was to keypunch the cards with the job titles; write a short program to compare one list with another, eliminating duplicates between lists; then edit new jobs for those relevant to our particular problem. Since complete consistency was not expected, we preliminarily analyzed the results of such a procedure with the following matrix:

Illustration of Selection Method

<div> <div>Year</div> <div>Job Title</div> </div>	1955	1958	1961	1964	1967	List of Possibilities
1	x	x	-	x	x	no
2	x	-	-	-	-	no
3	x	x	x	x	x	no
4	-	-	x	x	x	yes
5	-	-	-	-	x	yes
etc						

In the table, "x" indicates that the job title occurs, "-" that it does not occur. The "List of Possibilities" is the initial list which is developed simply by comparing one list to another, applying simple rules such as, "if the job occurs, then does not occur, leave it out;" and "if job does not occur, then occurs at a later date, include it."

Editing of "List of Possibilities": The list of jobs extracted using the above procedure was more inclusive than required for the present study. For example, such titles as "Human Factors Research Specialist," "Stability and Control Engineer," "Value Engineering Engineer" and "Reentry Systems Engineer" occurred on this list. Although these occupations may have developed as a result of aerospace-oriented activities, our particular interest was to eliminate all missile-or aircraft-oriented jobs, as well as "all other," leaving only those which were clearly and definitely space-oriented or space-derived.

Discussion of Newspaper Advertisement Search Method: The background for the newspaper advertisement search method was a very simple one--the hypothesis that as new job categories and activities were created, they would be advertised.

As a means to the end of finding new jobs, the newspaper search method is somewhat inadequate by itself. First, new jobs may be created in an organization and filled with existing personnel, without ever, or at least not at first, requiring formal methods of recruiting such as advertising. Second, the jobs advertised reflect to some degree job types or academic discipline rather than job or occupational titles. Thus, "chemical engineer," "physicist," "aerodynamicist," and even "engineer" are advertised consistently and continuously. Third, the more specific jobs, when they are requested often reflect the inertia of the aerospace organizations to respond to new types of jobs with new titles--in congruence with the problem encountered with the other search methods.

DESCRIPTION OF FUTURE PROGRAM

Objectives

The objectives of the future program described here are to a) complete the search in the Los Angeles area for the identification of new occupations solely due to the U.S. Space Program, b) establish in the process a detailed series of methods and procedures for such identification searches and to conduct these elsewhere in the country, and c) initiate (or, perhaps complete) the necessary understanding of the relevant problems that must be overcome in implementing new and descriptive job titles for the highly specialized participants in the space program.

A follow-on completion study now envisioned but not described here is based upon the ultimate objective, i.e. the requisite national plan for a) defining and b) adopting by establishment of appropriate job titles the new space-derived occupations.

Suggested Search Methods and Tasks

Query Personnel Managers, etc.--Industry, NASA, DOD

Extensive material on job titles, job descriptions, skill indices and similar qualifiers is expected to be received by SRI as a result of the pilot effort already undertaken in Los Angeles as described above (see section entitled Discussion of Initial Study and Methodology).

We propose a) to complete the task by additional personal conferences the search for new occupations based upon the space program, and b) to secure simultaneously the relevant background material--e.g. skill indices, job descriptions, etc.--to understand the problem sufficiently so as to generate and establish an appropriate and supplementary inventory of effective positions based upon the space program--compatible with (varying) industry-wide attempts now underway to re-classify their employment categories.

For the nation-wide follow-on we propose to expand this step to all other aerospace organizations (industry, NASA, DOD) on the basis of the routinized methods and good understanding gained in the task described above.

Query Other Government Agencies--ESSA, DOC, etc.

In order to learn to understand in the immediate future the tasks outlined above, we will query a few appropriate HQ functionaries in other government agencies now dealing with the space program about their plans and thoughts regarding their personnel descriptions and titles--particularly DOA, DOC, DOT, ESSA, HEW, NSF. This will largely expand our understanding of the real problem apparently experienced by all those now involved in sorting the descriptive titles of their personnel.

Query Career Centers, Employment Agencies, etc.

We have previously examined position titles employed by the career centers and agencies that are heavily involved in aerospace; they have also attempted to a) extract existing job titles from aerospace industries and b) establish their own job categories compatible with (a). We therefore propose to examine existing job title lists in career centers and to query their executives in regard to their background in establishing existing and future job categories.

Study of School Curriculae

13 In order to gain further understanding of the present background, and particularly in order to analyze the new occupations based upon the space program that can be projected, we intend to study the curriculae of technical schools and university extension schools. We will also query the appropriate curriculum directors in these institutions so as to acquire a firm background of the total change in occupations now taking place as a result of the space program.

Amplification of Newspaper Advertisement Search Method

For this phase of the study, we anticipate, in extension of the pilot experiment already conducted, a much more thorough search, with a considerably larger sample and a more judicious application of selection criteria in the preparation of initial lists of candidate occupations. We propose to extend the search media to professional journals and we anticipate that the use of computer data processing will probably also be expanded. The results of this effort would serve to extend and refine lists generated by the other techniques, as well as provide a means for more in-depth study of the problem.

A secondary objective of the task will be to study the delay in the response of job advertisements to the creation of new jobs in industry, and correspondingly, the appearance of advertisements for jobs for which there is no official title. It is strongly felt that data on both of these phenomena are essential to a better understanding of the new occupations problem.

Dictionary of Occupational Titles

In the initial phases of the pilot study, some attention was given to the use of the "Dictionary of Occupational Titles" (DOT), a publication prepared by the Bureau of Employment Security of the U.S. Department of Labor (8). This volume is probably the most comprehensive list of occupations available. Its primary--and crucial--problem, however, is delay time. Even in the latest revision available, (1965), no jobs at all are mentioned which have a clear space-derived orientation. On the other hand, there is usually a considerable time lapse between revisions and supplements, and we suspect that data closer to the compiling source may reveal additional occupations. According to representatives of the Employment Security Bureau, whom we already have contacted (24), preparation of the DOT is now being computerized, and should be complete in about six months. When this is accomplished it should be a simple matter to examine lists of new entries for appropriate titles. We intend to investigate this possibility also, as part of this task.

As the task proceeds we expect that it will also contribute to an understanding of the problem in depth. It cannot be overemphasized that such work is needed. We have found that almost all portions of this impact study are interrelated. The difficulty in tracing effects of the space program has its roots in the lag or delay time in responding to new concepts, ideas and activities. Occupational titles reflect this delay; thus they are worth studying from a theoretical as well as a practical standpoint in order to gain insight into the overall problem.

Bureau of the Budget Standard Occupational Classifications

Under the sponsorship of the Bureau of the Budget, an "Interagency Committee on Occupational Classifications" is now studying the development of a) uniform lists of occupational titles for all government agencies and b) cross-reference tables which would relate one such list, say that used by the Department of Labor with another list, i.e., that used by the Bureau of the Census.* SRI also proposes to make use of this work in its future program of research.

Initial phases of the task will consist of examining on-going work for relevance to the present problem. To do this, original lists and cross-reference lists will be examined for any new jobs which have not been found by other means. If none are found, the problem will be one of determining why the new jobs are missing, again in order to extend our understanding of the problem.

* This work is being carried out by the University of Pennsylvania. Initial SRI contacts have been established and we have assurances of cooperation from the parties involved (31).

Subsequently, the Interagency Committee lists of occupational classifications will be compared with several of the lists developed as a result of direct contacts with specific agencies. This should serve as a check for completeness, as well as a second method for determining time lags in getting new jobs into the various systems.

National Register of Scientific and Technical Personnel

A final search method to be examined is the use of data compiled for the National Register of Scientific and Technical Personnel. This biennial survey is conducted by the National Science Foundation, through the cooperation of various national professional societies.

For the 1968 survey, a new major grouping has been formulated, entitled "Atmospheric, Earth, Marine and Space Sciences." This grouping, as well as others, has associated with it an extensive list, which subdivides the various fields into their respective specialty areas. Respondents are asked to identify the specialty most closely related to their present employment, as well as those other specialties in which they have competence. It is the specialties lists which we expect to have relevance to the present study.

A problem with this method which has already come to light is the determination of a relationship between "specialties" and "occupational titles." For example, specialties in another of the major groupings, mathematics, are such items as Boolean algebra, combinatorial analysis, Hilbert spaces and time series (2). Understandably, these may be specialty areas, but it is unlikely that one would call himself a "combinatorial analyst." On the other hand, "demography" is another specialty area, and there are a good many demographers extant. Similar problems of translation will apply to the Atmospheric, Earth, Marine and Space Sciences grouping, as well as to other pertinent professional areas which may be found.

These problems will be resolved individually as the study proceeds.

Summary of Future Program

The identification methods of new occupations described above will provide the results required to fulfill objectives (a) and (b) above, and we are confident of these results in the light of our initial work already accomplished.

In order to fulfill objective (c), much background understanding and data analysis is required. It is intended to conduct this work so as to provide practical recommendations to effect, in the near future, government and industry-wide adoption of space-specific occupation titles.

CONCLUSIONS AND RECOMMENDATIONS

- New occupations solely due to the space program exist and have been established in industry and government alike--both in formal and informal inventories of job titles.
- More than a dozen of these occupations were readily found on the basis of a brief search described in this report. These are well defined--e.g. life support research scientist, space labs supervisor, etc.
- Five search methods for identifying these new occupations on a national basis were established and some were already tested.
- Identification of these new occupations in extension of the very small pilot search reported here can be confidently expected through further search and on the basis of search methods already established; SRI recommends that such study be continued.*
- Problems in identifying and establishing these occupations exist throughout the aerospace industry and the corresponding government organizations.
- These problems currently occupy personnel departments and government agencies alike.
- New rosters are being prepared by some of these organizations, and problems exist in their preparation.
- A uniform resistance to updating job titles in NASA and aerospace industry organizations is quite apparent--we are overwhelmed with the almost complete absence of descriptive space-related job titles in such organizations wholly committed to space work as JPL or in space divisions of aerospace companies.
- Intermediate sidestepping of these problems by some of these organizations include employment of non-descriptive job titles, establishment of qualifying job criteria, job descriptions, skill indices, and use of different job titles involving the same position for formal and informal purposes.

* Cooperation of outside organization required for further search was requested by SRI and the necessary assurances were already received.

- We feel that it is high time to recognize the 10-year old space program in the very organizations that operate it, and to replace obsolete and general job titles by descriptive terms, specifically relating to the space task at hand.
- There are problems that delay attainment of this goal and appropriate recommendations must be based on further study, e.g. time-trends and additional identification of the new occupations.

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